

Fig. S1. Mouthparts of a honey bee. (a) Mouthparts comprise three main parts: a pair of galeae, a pair of labial palpi and a glossa. Each segment of the glossa bears a ring of long hairs or microtrichia, which expand outwards as the glossa is extended into nectar. (b) Image of a feeding worker honey bee. (c) The glossal hairs are unfolding under the microscope, and their erection angle is θ . (d) The galeae and labial palpi form a feeding tube when a honey bee drinks sucrose solution.

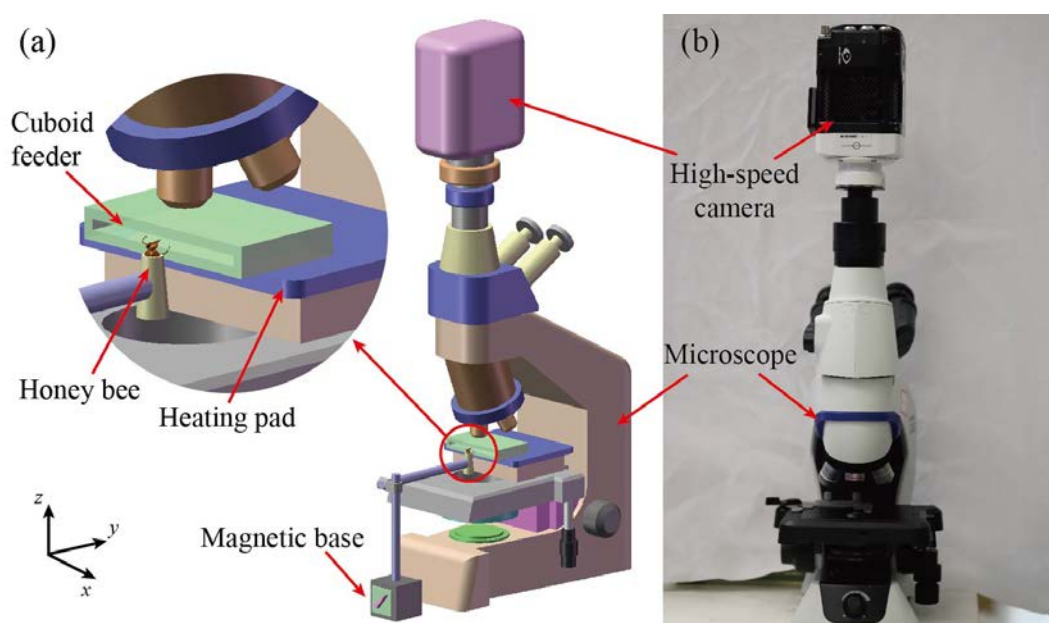


Fig. S2. Experimental setup for videography of the feeding process of a honey bee.

The specially designed system consisted of a high-speed camera (Phantom, Miro LC310, USA), a microscope (Olympus, CX33, Japan), and a heating pad (Fig. S2). The heating pad (temperature range $20^{\circ}\text{C} \sim 60^{\circ}\text{C}$, Smart-M, China) was used to maintain the temperatures of sucrose solutions. We operated this system to record the dipping processes of honey bees. In the experiments with Tylose, a digital viscometer (NDJ-5S, MINCEE, China) was used to measure the viscosity of sucrose solutions. The frame speed was 1000 fps.

(a) At the top-left corner, the enlarged figure shows that the temperature of sucrose solutions is kept constant by the heating pad. The cuboid feeder had 1 mm gap which was filled with sucrose solutions. (b) The movement of the proboscis is magnified by the microscope (5x) and filmed with the high-speed camera.

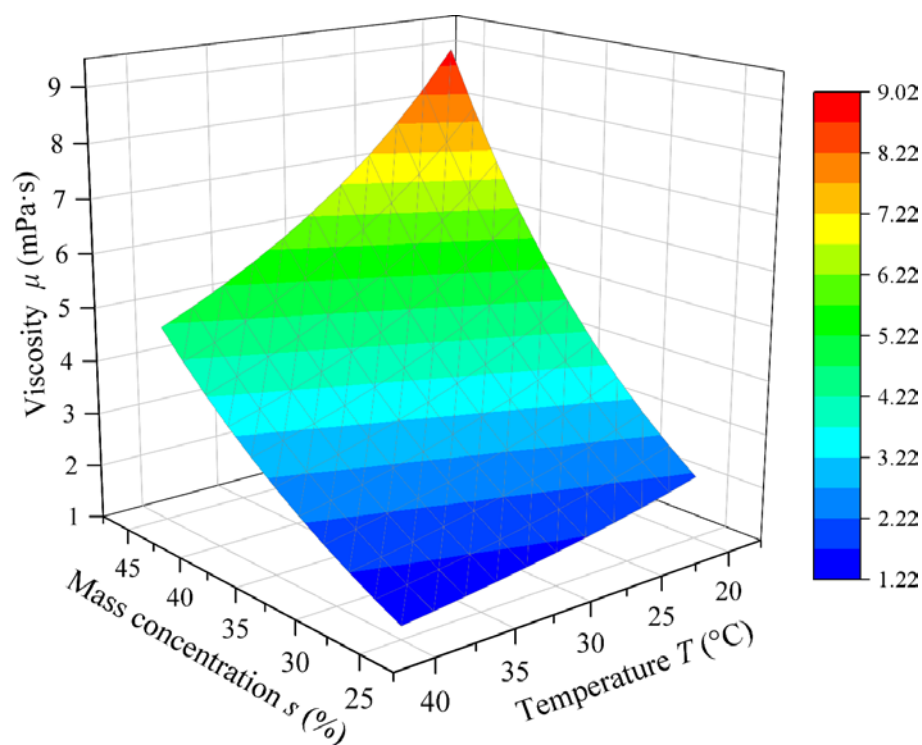


Fig. S3. Viscosity of sucrose solutions plotted against concentration and temperature.

We fit the viscosity formula and use the Origin software (Origin2018, OriginLab, USA) to plot a surface graph showing the relationship between viscosity μ , concentration s and temperature T .

Table S1. The glossal dipping frequency of honey bees fed different sucrose concentrations at different temperatures ($n = 10$ dipping cycles selected randomly from 3 videos for each group).

Sucrose concentration % w/w	Temperature (°C)	Dipping frequency (Hz)									
25	20	5.10	4.95	4.90	5.10	4.76	4.90	4.95	5.13	5.41	4.95
	25	5.10	5.21	4.67	5.75	6.13	4.85	4.83	5.38	6.06	4.88
	30	5.85	5.85	5.81	6.02	5.68	5.92	6.06	5.75	5.99	5.88
	35	5.88	6.25	6.62	6.25	6.02	5.92	6.49	6.37	6.29	5.85
	40	6.17	7.25	7.41	7.46	6.80	7.35	6.54	7.58	6.80	7.25
30	20	4.55	4.63	4.59	4.15	5.52	4.12	5.52	4.85	5.99	5.88
	25	4.90	6.02	4.55	5.21	4.85	5.00	5.92	5.38	4.55	4.69
	30	5.56	6.25	6.17	6.62	5.35	6.10	5.43	5.41	5.32	6.06
	35	5.75	5.68	5.71	6.25	5.59	5.78	5.68	6.94	6.94	6.80
	40	6.94	7.09	6.41	6.62	7.25	6.71	7.46	6.54	6.71	6.58
35	20	5.03	4.52	4.69	5.08	4.90	4.02	4.85	4.88	4.33	5.13
	25	4.78	5.05	5.18	4.81	4.81	4.78	5.05	5.46	4.95	4.98
	30	6.17	5.75	5.75	5.49	5.62	5.59	5.65	6.13	5.43	6.10
	35	5.81	6.25	6.10	6.25	6.17	6.02	6.06	5.85	6.29	6.17

	40	5.92	6.54	6.49	6.71	7.41	6.99	6.94	6.21	6.49	6.54
40	20	4.98	5.03	4.67	4.48	4.50	4.67	4.46	4.20	4.61	4.88
	25	4.65	4.76	4.74	4.95	5.49	4.61	4.52	5.08	4.69	5.00
	30	5.78	5.78	5.88	5.71	5.03	5.78	5.81	5.46	5.52	5.92
	35	6.54	6.67	5.38	5.05	5.85	5.38	6.10	5.81	5.68	5.81
	40	6.41	6.17	5.99	6.17	6.21	6.76	6.41	7.09	6.49	5.92
45	20	5.32	5.43	4.37	4.95	4.26	4.10	3.91	4.17	3.89	4.08
	25	4.29	4.90	5.05	4.55	4.88	4.93	4.65	5.08	4.41	4.55
	30	4.83	5.38	4.95	6.06	5.15	4.95	5.00	5.15	6.49	4.95
	35	6.06	5.56	6.17	5.78	5.56	5.08	5.38	5.26	5.88	5.59
	40	6.67	5.95	6.41	6.25	6.49	6.49	5.85	5.92	5.81	6.33

Table S2. The glossal dipping frequency of honey bees fed different sucrose concentrations at constant viscosity ($n = 10$ dipping cycles selected randomly from 3 videos for each group).

Temperature (°C)	Sucrose concentration % w/w	Viscosity (mPa·s)	Dipping frequency (Hz)									
25	25	7.2	4.93	4.27	5.05	5.00	5.13	4.76	4.55	4.42	4.48	4.69
	30	7.2	4.46	4.65	4.93	5.08	4.44	4.95	4.93	4.61	4.74	4.50
	35	7.2	4.78	4.74	4.46	5.15	4.42	4.95	4.98	4.57	4.67	4.57
	40	7.2	4.81	4.69	4.48	4.59	5.10	4.90	4.85	4.57	4.46	4.83
	45	7.2	4.46	4.90	5.05	5.03	4.88	4.93	4.98	4.29	3.89	4.90



Movie 1. The honey bee dips 40% nectar at 25°C.



Movie 2. The honey bee dips 45% nectar at 25°C.